(NASA-CR-150155) MULTI PURPOSE DISPLAY PANEL (Bendix Corp.) 21 p HC A02/MF A01 CSCL 09C

N77-17355

Unclas

G3/33 13840

Bendix Flight Systems Division

THE BENDIX
CORPORATION
FLIGHT SYSTEMS
DIVISION
TETERBORO,
NEW JERSEY

FINAL REPORT #
FSD-7411-76-5

MULTI PURPOSE
DISPLAY PANEL

CONTRACT NO.
NAS-8-31286

JULY 12, 1976

APPROVED BY Kenneth Kendall
K. KENDALL
PROJECT MANAGER

FOREWARD

This report documents the results of the work performed in the design and fabrication of the Multi Purpose Panel Demonstration Unit. It is submitted to the Marshall Space Flight Center by the Bendix Corporation, Flight Systems Division in compliance with the report requirements of Contract NAS-8-31286.

TABLE OF CONTENTS

1.0 SUMMARY

The successful fabrication of a Multi Purpose Panel (MPP) Demonstration Unit, using state of the art displays and electronic devices, has proven the feasibility and practicality of this concept in applications where useful control panel space is limited, or where control panel modifications or replacements are anticipated.

The MPP concept will become an increasingly more important factor in the simplification of this man-machine interface with further developments in the display and microprocessor technologies.

2.0 DESCRIPTION OF WORK PERFORMED

The Multi Purpose Panel (MPP) Demonstration Unit project was a four phase effort. The initial phase was a study of display technology to determine the feasibility of the MPP and to develop a practical approach. The results of that study are presented in Bendix, FSD, report number 7411-006-75-18 dated May 1975.

The remaining three phases, namely, the design, fabrication, and demonstration of the MPP Demonstration Unit, are the subject of this section.

2.1 MPP DEMONSTRATION UNIT

The MPP project was undertaken to demonstrate the feasibility of producing a control panel which could be time shared among several similar subsystems and which would permit rapid and inexpensive modification of control panel functions. It is intended to bridge the gap between Multifunction Display Systems, which offer excellent display flexibility but present man-machine interface problems, and dedicated control panels, which offer no flexibility.

Thus the primary object of the project was to determine the possibility of developing a control panel with programmable displays located near enough to control and display components to provide an acceptable man-machine interface. The fabrication of the MPP Demonstration Unit shown in Figure 2-1 proves the feasibility of this concept.

The basic elements of the MPP are as follows:

- Control switches and alphanumeric displays mounted on the front panel.
- Five component cards contain the electronic circuitry required for the storage and processing of display and switching information, display drivers, and interface circuits.

DEMONSTRATION UNIT

FIGURE 2-1

- Operating power provided by two 5VDC supplies, a logic supply, and a lighting supply.
- Interface connector provides connections for remote control of the panel and for command switch outputs.

2.2 MPP FRONT PANEL

The front panel layout was selected to represent typical switch locations which would appear on flight control panels. The switch groupings and locations were chosen arbitrarily to demonstrate the proximity that can be obtained. Since the alphanumeric characters are arranged in small clusters (the small displays in groups of four characters, and the large displays in groups of three, four, or five characters) different panel configurations can be obtained by rearranging the panel cutouts.

Each alphanumeric display is a red LED 5 x 7 matrix. The title block is a strip of 20 characters, .27 inch high. Switch identification is achieved using 84 characters, .15 inch high, spaced as shown in Figure 2-1.

Lighting power for a typical panel display was measured as variable between 4 watts at minimum brightness to 21 watts at full brightness. Power required for good viewing in a bright room was 15 watts. These power figures include the power dissipated in the LED's and the driver circuits. An additional 22 watts of logic power (TTL logic) is required for the memory, processing, and switch circuits.

2.3 MPP ELECTRONICS

Figure 2-2 is a block diagram of the electronics section of the Multi Purpose Panel. Information pertaining to panel nomenclature and command switch outputs is stored in PROM sets 1 through 8. Each PROM set contains all the information required for a particular subsystem. Thus, an entire subsystem may be changed or parts of any subsystem can be changed simply by replacing a PROM set. The subsystem to be controlled is selected by either a manual selector switch or by remote switching. The respective panel nomenclature and command signal lines for that system will then be activated. The external interface will consist of a 3 parallel line digital command for display selection and a number of discrete switch command outputs. A more detailed description of the functional blocks follows.

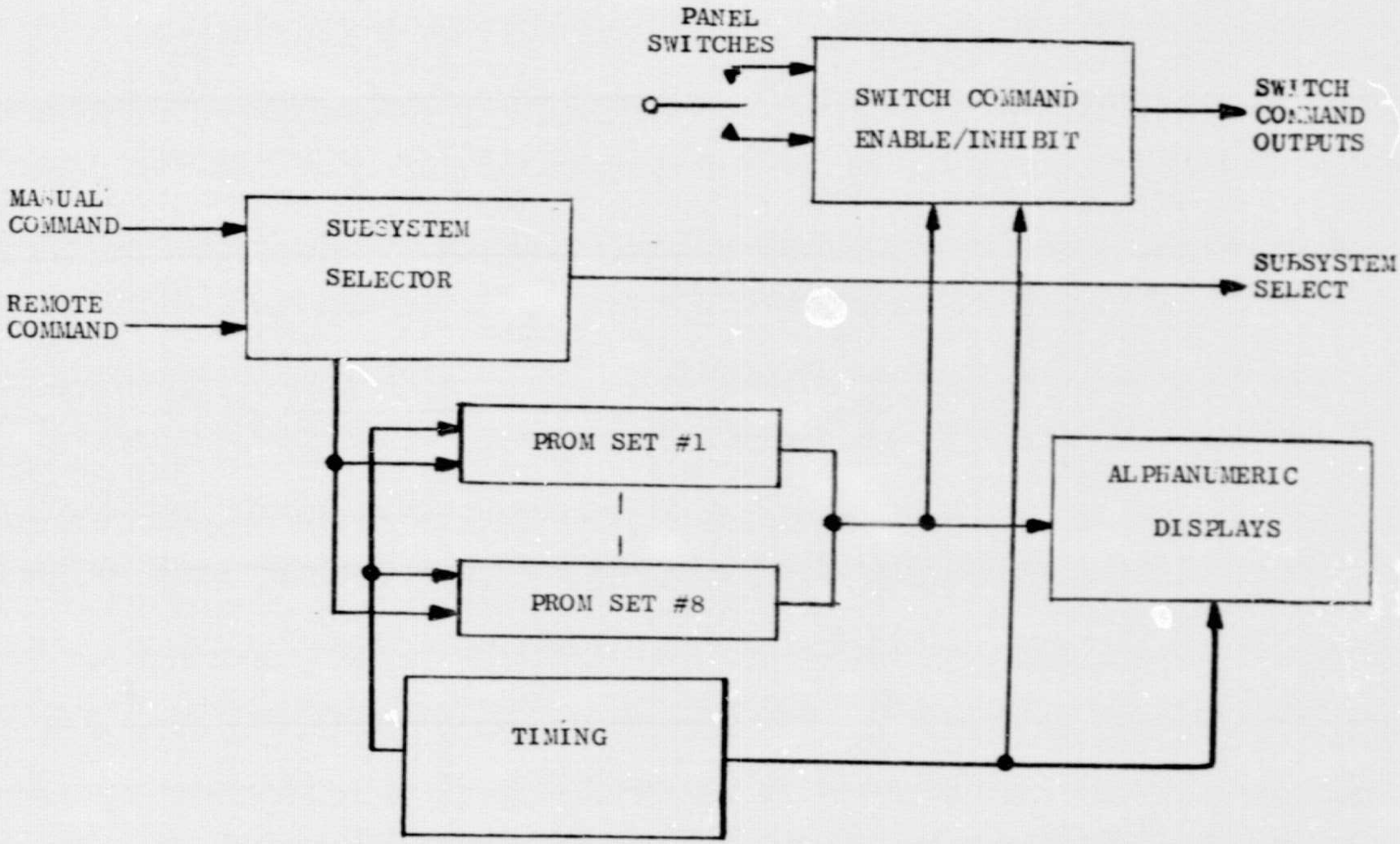

FIGURE 2-2
BLOCK DIAGRAM OF MULTIPURPOSE PANEL

MEMORY

Each PROM set will consist of four 32 x 8 bit memory devices and will provide enough capability to store data for up to 128 characters in ASCII format and to enable or disable the appropriate command switches. The PROM's are mounted in DIP sockets for easy replacement in order to facilitate field changes. To conserve power, 5 VDC is supplied by the subsystem selector only to the PROM set in use for a particular display selection.

Programming was implemented by assigning data locations as shown in Table 2-1, and burning in the PROM's (MM6331) using a Spectrum Dynamics Series 300 memory programmer.

This particular memory configuration was selected to achieve a self contained demonstration unit. If more flexibility was required, it could have been implemented by means of RAM which could be addressed from a keyboard, or data interface.

	BIT \ WORD		BIT \ WORD		BIT \ WORD		BIT \ WORD	
ASCII DATA SWITCH DATA "1"=ENA "0"=INH	1 6 8	1---------10 DS1 DS2 17--------26 DS3 DS4 S3 UP, S3 DN, S2 UP, S2 DN, S1 UP, S1 DN, S4 UP, S4 DN, R4, R3, R2, R1	1 6	31------------------------8 DS5 DS6 DS14 DS15 DS24 DS25	1 6	31------------------------4 DS7 DS8 DS9 DS10 DS11 DS12 DS13		31------------------------0 DS16 DS17 DS18 DS19 DS20 DS21 DS22 DS23

DISPLAY SET NO.	PROM NO.	PROM NO.	PROM NO.	PROM NO.
1	A41	A27	A13	A6
2	A40	A34	A20	A5
3	A45	A26	A19	A4
4	A48	A33	A12	A11
5	A39	A25	A18	A3
6	A44	A32	A17	A10
7	A38	A24	A16	A2
8	A43	A31	A23	A9

TABLE 2-1
MEMORY DATA LOCATIONS

SUBSYSTEM SELECTOR

The Subsystem Selector activates a particular set of display and switch data upon receipt of a manual command from the "Display Select" switch mounted on the front panel or a remote command selector which is enabled when the "Display Select" switch is in the "CVT" position. A remote command is entered by means of a three line BCD input, the selected display being the one corresponding to its BCD value with the exception that display number 8 corresponds to a BCD value of 0. The MPP electronics is initialized at each new selection.

A "Display Enable/Inhibit" switch is also provided if it is desirable to inhibit the MPP during display changes (e.g., to reset panel switches between display changes).

The Subsystem Selector also provides output signals for an external indication of which subsystem is activated.

TIMING

The Timing circuits provide stable clock signals for cyclic memory addressing, alphanumeric display multiplexing and command switch gating.

COMMAND SWITCH ENABLE/INHIBIT

The Command Switch Enable/Inhibit circuits gate the outputs of the 4 toggle switches and the rotary switch located on the front panel with an Enable/Inhibit bit stored in memory for each switch output. These gated signals are then buffered to be compatible with MSFC Interface Definition Document 40M35716.

ALPHANUMERIC DISPLAYS

As mentioned previously, two different types of alphanumeric displays are utilized on the MPP. Both displays are multiplexed to reduce the amount of drive electronics and interconnections, and to improve the efficiency of the display devices.

The .27 inch high devices are Hewlett Packard 5082-7100 LED displays. They are 5 x 7 dot matricies and are addressed in the manner shown in Figure 2-3. This configuration approaches the optimum time sharing possible, the limiting factor being the LED current rating. (The peak instantaneous current through each element increases proportionally with the number of elements multiplexed to maintain a constant brightness.) The display is refreshed at over 100 times per sec. to eliminate display flicker. Brightness control is performed by varying the duty cycle of the row drivers.

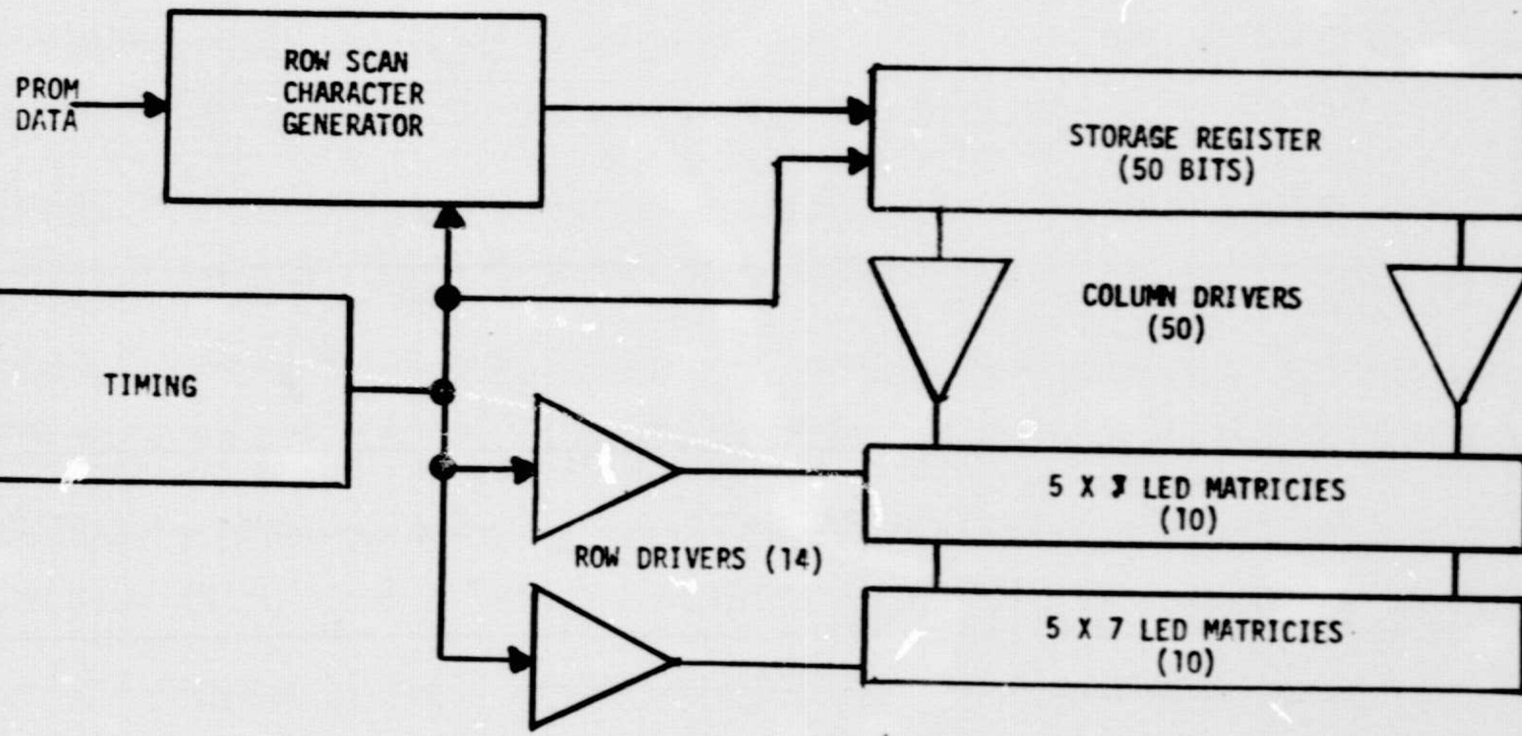

FIGURE 2-3

MULTIPLEXING

5082-7100 LED'S

The smaller displays, HP 5082-7150 alphanumeric displays, are also 5 x 7 dot matrices, but also contain a serial in serial out shift register for address storage, and element drivers in one integral package. Activation of these displays, as shown in Figure 2-4, is much more straightfoward and requires relatively little volume for address and driver electronics. The size and quality of the display are excellent for control panel applications, and it is recommended that this type device be used for all programmable nomenclature on future MPP efforts. These displays are also refreshed at over 100 times per second, and brightness is controlled by varying the duty cycle of the column drivers.

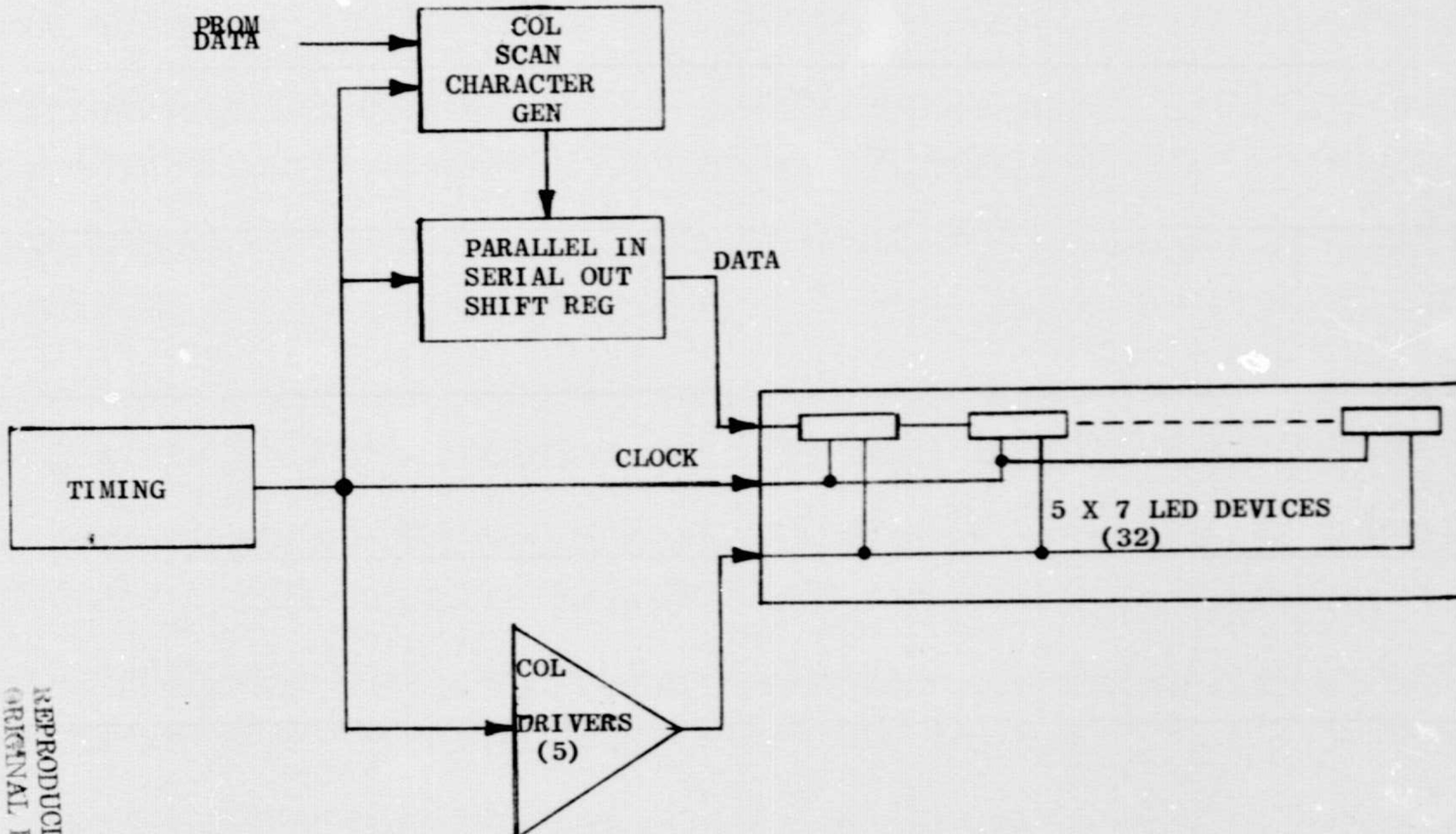

FIGURE 2-4

MULTIPLEXING
5082-7150 LED'S

2.4 POWER SUPPLIES

For demonstration purposes, space and power were not restraining factors. Therefore commercial, series regulator, power supplies were selected for economy These 5 VDC supplies operate from 115V, 60 Hz and contain overvoltage and over-current protection.

The logic supply (PS1) is capable of delivering 6 amperes. The Demonstration Unit load requires 4.4 amperes. The lighting power supply has a 12 ampere capacity, although a maximum of 4.2 amperes is required for display lighting. The original power estimate was overly conservative because of the ambiguity created by the total number of elements excited in a random display, and the increase in lighting efficiency due to multiplexing LED's.

2.5 INTERFACE CONNECTOR

An interface connector is provided in the rear of the MPP Demonstration Unit for access to remote display selection inputs, and command switch outputs. The connector pin functions are listed in Table 2-2.

J1 PIN FUNCTIONS

A - Remote Data Select A (LSB)	T - Tog. Sw. Output S4-DN
B - Remote Data Select B	U - Tog. Sw. Output S2-DN
C - Remote Data Select C	V - Supply Voltage for Remote Data Select (5 VDC)
D - Rotary Sw. Output R1	W - Data Select No. 1
E - Rotary Sw. Output R2	X - Data Select No. 2
F - Rotary Sw. Output R3	Y
G - Rotary Sw. Output R4	Z
H	a
J - Ground	b
K	c - Data Select No. 3
L - Tog. Sw. Output S1-UP	d - Data Select No. 4
M - Tog. Sw. Output S1-DN	e - Data Select No. 5
N - Tog. Sw. Output S2-UP	f - Data Select No. 6
P - Tog. Sw. Output S3-UP	g - Data Select No. 7
R - Tog. Sw. Output S3-DN	h - Data Select No. 8
S - Tog. Sw. Output S4-UP	j

TABLE 2-2

3.0 CONCLUSIONS

The stated purpose of the MPP project is to demonstrate the feasibility of constructing a control and display panel with easily changeable nomenclature. The fabrication of a Demonstration Unit has proven the practicality of creating such a panel with programmable displays which can be located in close proximity to panel hardware. The result is a flexible control panel which meets generally acceptable human factors standards and makes efficient use of control panel area.

The completion of this project is actually a preliminary step in the development of Multi Purpose Panels. The continuing improvements in electronic display technology, most notably gas plasma and PLZT displays, are producing new and better display alternatives for implementation in an MPP. At the same time, rapid advances in integrated circuit technology are reducing the power and volume requirements of the MPP processing and driver circuits.

During the course of this project, the MPP has often been mistakenly considered as a universal panel, i.e., a standard control panel which can be programmed to perform control and display functions for any situation. The original intent of the MPP was for use in applications where panel space is limited, but a number of similar subsystems must be controlled, or for use where basic panel nomenclature and functions must be changed rapidly, as in the case of between mission changes of Space Shuttle payloads. In the first case, panel area limitations are overcome by time sharing a central control

panel among several subsystems. In the latter case, entire control panel changes are effected by simply replacing a memory module, thereby reducing the extent of installation and checkout procedures between missions. In either case, a basic panel layout consisting of the command devices and status readouts necessary to meet the system requirements must be generated, and the adaptability of an MPP to meet these needs must be investigated.

With the successful completion of the MPP project, and with the advent of microprocessors, MPP applications can be extended. By incorporating a CPU in the MPP, an operator can be led through a complex decision tree by the MPP. The MPP would display the options available to the operator based on previous decisions and the present status of the systems, and the operator would then select the desired option. In this case, the MPP offers the advantage of situating the display and command functions in such a way as to minimize human error.